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Assessing the accuracy and adequacy of India's national energy balances: Implications for tracking sustainable development and climate goals

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National energy balances are essential for estimating various socioeconomic and environmental development indicators, including carbon-dioxide emissions. The Ministry of Statistics and Programme Implementation (MOSPI) annually publishes India's energy balance. However, the widely used source of India's energy balance is International Energy Agency (IEA). In this paper, I compare the data from the two sources and find that MOSPI's energy balance estimates are different from IEA's. The estimates of per capita energy consumption and energy intensity from MOSPI are 26% higher than IEA for 2019-20. Another issue in MOSPI's data is the incomplete disaggregation of final energy consumption by end-use sectors. Energy consumption from oil products reported in the non-specified category in MOSPI tables is 40% of the total consumption. Due to this, the agriculture energy intensity is 33% lower, and the transport energy intensity is 43% lower than IEA. India's carbon dioxide emissions from MOSPI's energy balance estimate are 31% higher than IEA.

Keywords: Sustainable development, indicators, carbon dioxide emissions, energy balance table, national energy statistics

JEL Code: Q4, K3, O13

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Abstract

National energy balances are essential for estimating various socioeconomic and environmental development indicators, including carbon-dioxide emissions. The Ministry of Statistics and Programme Implementation (MOSPI) annually publishes India's energy balance. However, the widely used source of India's energy balance is International Energy Agency (IEA). In this paper, I compare the data from the two sources and find that MOSPI's energy balance estimates are different from IEA's. The estimates of per capita energy consumption and energy intensity from MOSPI are 26% higher than IEA for 2019-20. Another issue in MOSPI's data is the incomplete disaggregation of final energy consumption by end-use sectors. Energy consumption from oil products reported in the non-specified category in MOSPI tables is 40% of the total consumption. Due to this, the agriculture energy intensity is 33% lower, and the transport energy intensity is 43% lower than IEA. India's carbon dioxide emissions from MOSPI's energy balance estimate are 31% higher than IEA

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1. Introduction

National energy statistics are essential to track a country's progress in its development goals (Vera 2007). Energy data is also crucial to estimating carbon dioxide emissions from energy use (Bruckner 2015). Carbon dioxide (CO_2) emission from energy use is the key driver of the climate change crisis. Most countries have pledged reductions in carbon dioxide emissions or emissions intensity under the United Nations Framework Convention on Climate Change (UNFCCC) framework. Carbon dioxide emissions data is critical for monitoring the progress in meeting the emission reduction targets.

Countries collate their energy statistics and present them in energy balances (UN 2017). An energy balance is an accounting framework for the compilation and reconciliation of data on all energy products entering, exiting, and used within the national territory of a given country during a reference period. Energy balances are essential to calculate energy indicators of development and estimate CO_2 emissions from energy use. Figure 1 shows a few energy indicators of development and the required data.

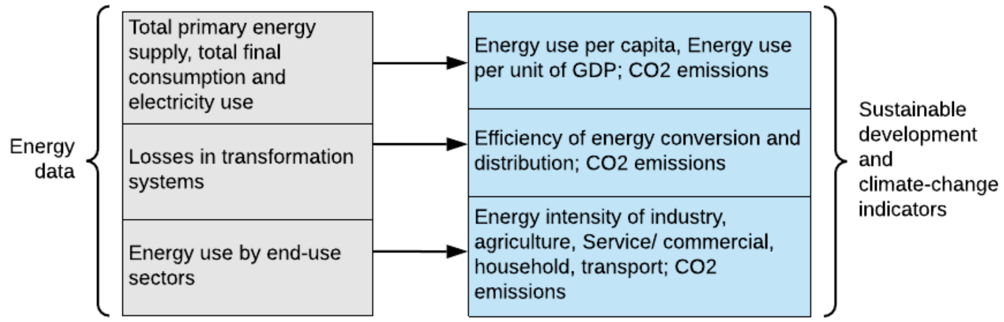

Figure 1 Energy data used to calculate key indicators of development

The official source of India's energy statistics is the annual publication by the Ministry of Statistics and Programme Implementation. Given the importance of the energy balance, MOSPI began publishing energy commodity balance in the 2010 edition and energy balance in standard energy units in the 2012 edition (MOSPI 2010, 2012). The other source of India's energy balance is IEA's world energy balance estimated from IEA's world energy statistics. Most of the estimates of India's CO_2 emissions use IEA energy balances. IEA collects energy statistics from various countries through annual questionnaires or national publications and reports (IEA 2020).

MOSPI's energy statistics' is rarely used in research or government reports despite being national data. For example, in the chapter on sustainable energy, India's Economic Survey 2018-19 refers to data from World Bank and British Petroleum on India's per capita energy consumption (ES 2019). Similarly, most research studies on energy supply obtain data from international organisations (Karstensen 2020). Few studies have compiled national energy statistics using data from different energy ministries (Das 2020).

Energy statistics-related issues in India have been raised several times (Andrew 2020, Rai 2017, Dukkipati 2015). The problems pertain to either sufficiency of the data or errors in it. To develop a national energy dataset and provide single-window access to the country's energy data, NITI Aayog, in collaboration with Prayas, launched the 'India Energy Dashboard (IED)' in 2017. The dashboard offers state-wise production and consumption of all energy sources. However, the dashboard does not provide fuel-wise consumption of energy products in the end-use consumer category.

Research on India's development and climate goals requires sector and sub-sector-level estimates of CO_2 emissions. India reports its GHG emissions in the Biennial Update Report to UNFCCC. The GHG emissions inventory includes estimates of CO_2 emissions from the energy sector. However, the underlying energy data used to calculate the emissions are not released. There are efforts from independent organisations to collect, compile and disseminate emissions data, particularly to complement the existing data (GHGPI 2017).

This article aims to advance the discussion on India's national energy statistics to effectively track its energy and climate goals. Keeping the focus on energy balance tables, I compile energy balances from MOSPI's national energy statistics for 2010-19 and compare them with IEA energy balances. Then I estimate energy indicators of development and CO_2 emissions using the two sources for 2019-20 and compare them. I find that energy balances reported in MOSPI's energy statistics have errors and are inadequate. These energy balances, if used, can provide incorrect estimates of India's key energy statistics, such as energy intensity, the efficiency of energy conversion and transmission, and energy intensities of industry and agriculture. The availability of reliable energy balance tables from a country's official sources is essential for research on tracking improvements in energy efficiency and fuel diversification to meet India's development and climate goals. Hence MOSPI's energy balance tables must be corrected to provide a reliable source for national energy statistics.

2. India's energy statistics reports

Energy statistics facilitate reliable and timely monitoring of the supply and use of energy. It is a collated database of the flow of energy sources in an economy. It provides data on energy flows, including production, import, exports, bunkering, stock changes, transformation, energy use by energy industries, and losses during the conversion and final consumption of energy products within the national territory. Ministries and various organisations provide data on the flow of energy products in physical quantities. The energy equivalent is estimated using the energy content of different products.

Most countries follow the International Recommendations on Energy Statistics (IRES) adopted by United Nations Statistical Commission in 2011 to develop national energy statistics (UN 2017). IRES recommended the compilation of energy balances to enhance the relevance of energy statistics and serve as a quality tool to ensure completeness, consistency, and comparability of basic statistics. An energy balance is an accounting framework for the compilation and reconciliation of data on all energy products entering, exiting, and used within the national territory of a given country during a reference period.

Ministry of Statistics and Programme Implementation (MOSPI) publishes India's national energy data. MOSPI's Energy statistics is an annual publication and contains the previous financial year's data. For example, the edition published in 2021 includes data for 2019-20. Each issue collects energy statistics for the past ten years. MOSPI sources data on energy products from various ministries dealing with different energy products and compiles them. MOSPI's energy statistics have sections such as energy production, energy availability and energy consumption. These tables give energy data in both physical quantities and energy equivalents.

MOSPI follows IRES recommendations to prepare India's energy balance. Given the importance of the energy balance table, MOSPI began publishing energy commodity balance in the 2010 edition and energy balance in standard energy unit in the 2012 edition. Hence, the energy commodity balance and energy balance in standard energy units are available from government data since 2007 and 2010. Since the 2017 edition of its Energy Statistics, MOSPI began reporting a few of the energy indicators of sustainable development. It estimates ten indicators under the use, production pattern, and security (Table 1). It utilises the data reported in its energy balance tables to calculate the indicators.

Table 1 List of indicators tracked in MOSPI's energy statistics

S.No	Theme	Indicator
1	Overall Use	Energy use per capita
2	Overall Productivity	Energy use per unit of GDP
3	Supply Efficiency	Efficiency of energy conversion and distribution
4		Ratio of TFC and TPES
5	End Use	Sectoral Energy Intensities
6		Sectoral Electricity Intensities
7	Diversification (Fuel Mix)	Fuel shares in TPES
8		Fuel share in TFC
9		Fuel share in electricity
10	Imports	Net energy import dependency

3. India's energy balance tables

The energy balance tables record the flow of all the energy sources from production and imports to final consumption. The significant flows for estimating development indicators and CO2 emissions are production, imports and exports, fuel transformation, and final consumption by end-use sectors. According to the IRES, an energy balance matrix shows the relationship between energy products (represented in columns) and flows (represented in rows). The rows are sequenced such that there are three main blocks of rows. The top block shows energy entering and leaving the national territory and stock changes to provide information on the supply of primary energy (TPES). The middle block shows how energy is transformed, transferred, used by energy industries, and lost in transmission and distribution. The bottom block shows the final energy consumption and non-energy use of energy products. In the following sections, I compare the three blocks of MOSPI's and IEA's energy balances for 2019-20. I also compare the values from the IED energy balance in the energy supply blocks.

3.1. Energy supply

The primary energy supply in the top block of the energy balance is calculated as energy production plus energy imports, minus energy exports, minus international bunkers, and then plus or minus stock changes. The top block of MOSPI's and IEA's energy balance for 2019-20 is shown in Table 2. As per MOSPI's data, India's primary energy supply in 2019 was 946 mtoe, 26% higher than IEA data. Primary energy from coal in MOSPI's data is 607 mtoe compared to 420 mtoe in IEA data. The two datasets' primary energy estimates of other energy sources are similar.

Table 2 India's primary energy supply flow in 2019-20 from MOSPI and IEA energy balance table

MOSPI									
Energy flow (in mtoe)	Coal and Lignite	Crude oil	Oil Products	Natural gas	Nuclear	Hydro	Renewables	Electricity	Total
Production	433	33		29	12	13	12		533
Imports	161	232	45	31				0.5	469
Exports	-1		-69					-1	-69
Stock change	14								14
Primary energy	607	265	-23	60	12	13	12	-0.27	946
IEA									
Production	289	38		25	12	15	12		391
Imports	133	233	43	30				1	440
Exports	-1		-71					-1	-72
Bunker			-6						-6
Stock change	-1	-1	0.3						-2
Primary energy	420	270	-34	56	12	15	12	0	751

Source: MOSPI 2021, IEA 2021

Primary energy supply is calculated as production plus imports minus exports plus stock changes. The positive values indicate inflows and negative values indicate outflows

Primary energy supply from nuclear, hydro and renewables is estimates by applying an assumed conversion efficiency to the electricity generated from these sources

All values are energy equivalent estimated by multplying the physical quantities of fuels with their energy content (Net Calorific Value)

The estimates of primary energy from IED are the same as IEA data. The primary energy supply from MOSPI, IEA, and IED for 2012-2019 is plotted in Fig 2. The primary energy supply estimated from MOSPI is similar to IEA and IED estimates for 2013 and 2015 but not for other years. As per MOSPI's energy statistics, India's primary energy supply increased at a CAGR of 5.1% during 2010-19. However, the corresponding values from IEA and IED data are much lower at 3%.

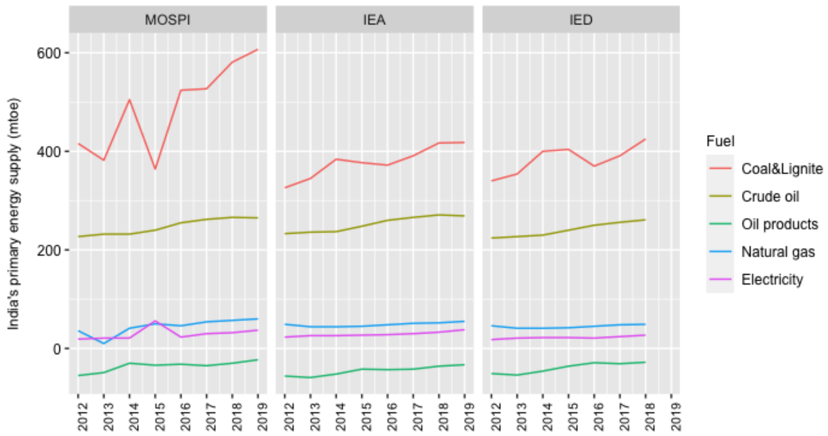

Figure 2 India's primary energy supply by fuel from three datasets

Source: Compiled by author from MOSPI energy statistics, IEA energy balances and IED energy balances

Note: Primary energy supply in MOSPI data is around 26% higher than in IEA and IED for all years except 2013 and 2015.

It is evident from the fuel-wise primary energy supply data that the difference across the three datasets is mainly due to estimates of energy from coal. The share of coal in the primary energy supply in MOSPI's data is around 63-65% in all the years except 2015. On the other hand, the share of coal in IEA and IED datasets is less than 60% for all the years. This difference is shown in Figure 3. Figures 2 and 3 confirm the presence of a bias in MOSPI's energy balance data for most of the years.

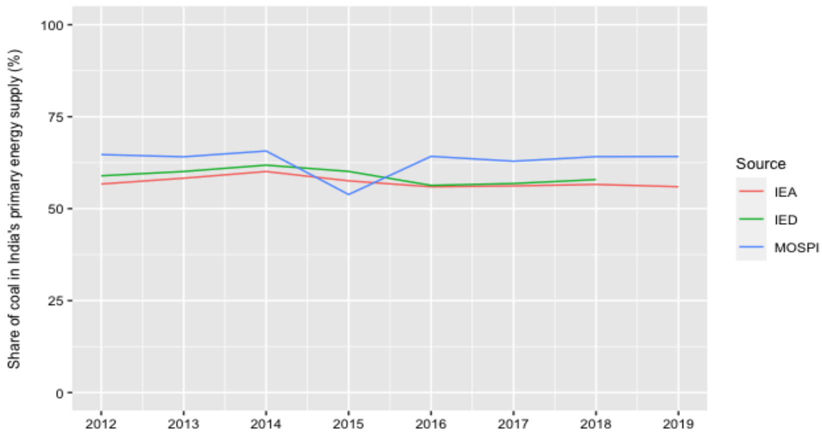

Figure 3 Share of coal in India's primary energy supply from three datasets.

Source: Compiled by author from
Note: MOPSI data indicates a higher share of coal in primary energy supply as compared to IEA and IED

A possible reason behind the difference in the estimates of energy derived from coal in MOSPI's energy balance table is the choice of calorific value of coal. The energy derived from coal in other tables of MOSPI's energy statistics also differs from that of the energy balance table. For example, 731 MT of coal produced in 2019 is 264 Mtoe (11058 TJ) in coal production data and 433 Mtoe in the energy balance table. It implies that the average calorific value of domestic coal in 2017, calculated from MOSPI's energy balance tables, is 5956 kcal/kg and from its coal production data is 3616 kcal/kg. The difference in the assumption of the calorific value of coal increased India's primary energy supply estimate. It also changed the shares of energy sources in the primary energy supply.

3.2. Energy conversion transformation and distribution

The primary energy from coal is converted to electricity in power plants, and that from crude oil is converted to oil products in oil refineries. Energy transformation is carried out to convert an energy product to another more suitable for specific use. Most primary energy sources, such as coal and crude oil, are transformed into electricity and oil products for final use. Some of the coal and natural gas are used directly by end-users. The energy lost in conversion, transformation, and distribution is reported in the middle part of the energy balance table. Table 3 shows the central block of India's energy balance table for 2019-20 from MOSPI's and IEA's energy balances.

Table 3 Energy transfers, transformation, energy industry own use and losses in India (2019-20)

All values in mtoe	MOSPI								
Energy flow	Coal and Lignite	Crude oil	Oil Products	Natural gas	Nuclear	Hydro	Renewables	Electricity	Total
Primary energy	607	265	-23	60	12	13	12	-0.3	946
Statistical differences	37	19	-26	-2				21	49
Electricity plants	-420		-1	-10	-12	-13	-12	121	-362
Oil refineries		-260	271	-7					4
Energy industry own use				-9				-7	-17
Losses		-24		0				-23	-47
Total Final Consumption	224		221	31				111	587
	IEA								
Primary energy supply	420	270	-34	56	12	15	12	-0.3	751
Transfers		3	-3						0
Statistical differences	-4	-4	-6	0				8	-5
Electricity plants	-286		-3	-14	-12	-15	-10	138	-202
Oil refineries		-269	272						3
Coal transformation	-21								-21
Energy industry own use	-2		-18	-7				-12	-39
Losses								-23	-23
Total Final Consumption	107		209	34			1	113	465

Source: MOSPI 2021, IEA 2021
Primary energy supply from coal is converted to electricity in electricity plants and that from crude oil to oil products in refineries
Energy is lost in tranformation from coal to electricity in electricity plants
Energy used in electricity plants and refineries reported in own use
Energy lost in distribution is reported under losses

The total electricity generated from all energy sources is given under electricity plants. The gross electricity generated is 1407 TWh (121 mtoe) in MOSPI's energy balance and 1604 TWh (138 mtoe) in IEA's energy balance. As per Central Electricity Authority (CEA), the electricity generated in 2019-20 was 1623 TWh (140 mtoe), 13% higher than MOSPI energy balance data. On the other hand, the IEA estimates of electricity generation match the CEA data. It is found that MOSPI's energy balance has a much larger value under statistical difference than IEA, resulting in a discrepancy.

The energy balance tables give information on primary energy sources and total electricity generated from all energy sources. For example, the energy supply for electricity generation from thermal energy sources, as per MOSPI's and IEA energy statistics, is 431 mtoe and 303 mtoe, respectively. The primary energy supplied by nuclear is 12 mtoe in both energy statistics, but hydro and renewable differ. In both IEA and MOSPI energy statistics, the efficiency of transforming primary energy to final energy is assumed to be 33% for nuclear and 100% for hydro and nuclear. Thus, the electricity generated from non-thermal energy sources in both data sets is 29 mtoe. The electricity generated from thermal energy sources is 92 mtoe in MOSPI's data and 111 mtoe in IEA data.

3.3. Final energy consumption

The bottom block of the energy balance table provides information on fuel-wise energy used by various end-users. The energy not-specified under any consumer category and the energy sources used for non-energy uses are reported separately. The energy used by the consumer category is required for estimating energy intensities of economic production from agriculture, industry, services, and transport. India's final energy consumption in 2019-20, reported in MOSPI's and IEA energy statistics, is shown in Table 4.

Table 4 Final energy consumption by end-users and fuel in 2019-20

All values in mtoe	MOSPI				
Energy flow	Coal and Lignite	Oil Products	Natural gas	Electricity	Total
Total final consumption	224	221	31	111	587
Industry	224	56	1	47	328
Transport		48	10	1.68	60
Residential		28		27	55
Commercial and public services		0		9	9
Agriculture/forestry		1		20	21
Non-specified (other)		89		7	95
Non-energy use		31	20		52
	IEA				
Total final consumption	107	209	34	113	465
Industry	95	31	7	47	180
Transport		99	3	1.69	104
Residential	3	28	1	27	61
Commercial and public services	5	3	2	10	20
Agriculture / forestry		11	0	20	31
Fishing					0
Non-specified	5	5		7	18
Non-energy use		31	20		52

Most of the coal available for final consumption is used by industry
Some energy is used for non-energy purpose such a feedback stock in industry
Energy not categorised under any end-use is reported in non-specified

The estimates of final consumption in IEA energy statistics differ from MOSPI's energy statistics. As shown in Table 4, the final energy consumption in MOSPI's statistics is 26% higher than in IEA. Due to the higher value estimated in the final energy consumption, the energy consumed by industry is 83% more in MOSPI's energy balance than IEA estimates.

Industries consume coal, oil products, natural gas and electricity. As per IRES recommendations, an energy balance table gives data on energy consumed by various industrial sectors such as iron and steel, chemical and petrochemical, non-ferrous metals machinery etc. MOSPI's energy statistics list all the sub-sectors but report two-thirds of the energy consumption in non-specified. The disaggregation is also incomplete for oil products, as 40% of the consumption is reported under non-specified. Most of the oil products are used in industry and transport. In MOSPI's data, industry consumption is overestimated, and transportation and agriculture are underestimated.

4. Results

The indicators of sustainable development reported in MOSPI's energy balance tables are compared with that of the IEA. The CO_2 emissions from fossil fuel combustion from the two data sources are also calculated and compared. As discussed above, the differences in the energy balance tables of the two data sources adversely affect the estimates of the indicators.

4.1. Indicators of sustainable development

The indicators of sustainable development reported in MOSPI's energy statistics are divided into the themes of use, production patterns and security of energy supply. Five sub-themes under production patterns, one under security, and ten indicators are reported. I discuss the per capita energy use and intensity indicators, energy conversion and distribution efficiency, intensities of end-use energy consumption, and diversification in the fuel mix.

4.1.1. Per capita energy use and energy intensity

Per-capita energy consumption and energy intensity are calculated using primary and final energy supply. Per-capita energy consumption is the ratio of energy and population. Energy intensity is the ratio of energy and economic output. The gross domestic product is taken to estimate the economy's energy intensity. The estimated values are shown in Table 5. Due to the higher estimates of TPES and TFC, the per capita energy consumption and energy intensity are 26% higher in MOSPI data than in IEA data. The electricity consumption is the same in the two datasets; hence, the electricity indicators are identical.

Table 5 Indicators of overall energy use in India in 2019-20

	MOSPI	IEA	% Difference
Per capita TPES (kgoe/capita)	706	560	26%
Per capita TFC (kgoe/capita)	438	347	26%
Per capita electricity (kWh/person)	963	960	0%
Energy intensity TPES (kgoe/'000 rupees)	6	5	26%
Energy intensity TFC (kgoe/000'rupees)	4	3	26%
Energy intensity electricity (kWh/'000 rupees)	9	9	-2%

Source: MOSPI 2021 and IEA results estimated from IEA 2021

4.1.2. The efficiency of energy conversion and distribution

Energy is lost in conversion from coal to electricity and transmission and distribution of electricity. MOSPI reports this indicator for 2019-20 as 19%. It is calculated as the ratio of electricity available for final consumption and the primary energy supplied. The electricity available for final consumption in MOSPI is 111 mtoe and 113 mtoe in IEA. The statistical differences are subtracted from these values to arrive at the electricity available from the generated electricity. The statistical differences in MOSPI and IEA are 21 mtoe and 8 mtoe. The electricity available for consumption from the generated electricity is 90 mtoe and 105 mtoe. The primary energy supplied to the electricity plants is 469 mtoe in MOSPI and 340 mtoe in IEA. The ratio of output electricity of 90 mtoe and input of 469 mtoe gives 19%. Similarly, the ratio of the output of 105 mtoe and input of 340 mtoe is 31%. Hence, while energy conversion and distribution efficiency is 31% as per IEA data, it is much lower at 19% in the MOSPI data.

4.1.3. Intensities of end-use energy consumption

Intensities of end-use consumption are helpful indicators for analysing the effects of efficiency improvements in the sectors. The intensity of economic production sectors such as agriculture and industry is the ratio of energy used in the sector and the value added by the industry. As mentioned above, the estimates of industry, agriculture and transport energy intensities widely differ in the two datasets (Table 6). Further, in MOSPI statistics, transport intensity is estimated as the ratio of energy consumed in the transport sector and the value-added by the transport sector. However, this is not an appropriate measure of transport energy intensity as the transport sector adds value to the entire activity. The value added by the transport sector is not an accurate indicator of activity in the sector. The preferred indicator for activity in transport is the vehicle miles travelled or GDP.

Table 6 Sectoral energy intensities in 2019-20

	Value added (Rs. crore)	Energy (mtoe)		Energy intensity (kgoe/'000 Rs)		
		MOSPI	IEA	MOSPI	IEA	% Difference
Industry	3,627,074	328	180	9.0	5.0	83%
Agriculture	1,968,571	21	31	1.0	1.6	-33%
Transport	639,779	60	104	9.4	16.3	-43%

Source: MOSPI 2021 and IEA results estimated from IEA 2021

Note: Energy intensity is estimated as the ratio of energy and value added by the sector

4.1.4. Diversification in the fuel mix

The indicators under the fuel mix are used to track improvements in the growth of renewable energy sources in the supply. The difference in the estimates of energy from coal distorts the estimates of the share of different energy sources in the fuel mix. The percentage of coal is 64% in MOSPI and 56% in IEA. The share of renewable and nuclear in the primary energy supply is 4% in MOSPI and 5% in IEA. However, the difference is minor but is significant for the small share of the non-fossil energy sources.

4.2. Carbon dioxide emissions

Carbon dioxide emissions from fossil fuel combustion are estimated using the primary energy supply or activity-wise energy consumption. A few organisations, such as British Petroleum, use the primary energy supply data to estimate CO_2 emissions. IEA uses its energy balances to make estimates of CO_2 emissions using sector-wise energy use data. The default emission factors from IPCC are 73.3 t/TJ for crude oil, 96.1 t/TJ for coal, and 56.1 t/TJ for natural gas.

The estimate of CO_2 emissions from IEA energy statistics is 2.5 Gt of CO_2, which from MOSPI is 3.3 Gt of CO_2. The MOSPI estimates are 31% higher than IEA estimates.

5. Conclusion and policy implication

Energy balances are essential to track a country's development and climate-related goals. The IEA's energy balance is the widely used energy balance data source to analyse India's energy transition and progress in meeting climate goals. Most currently used estimates of CO_2 emissions from fossil fuels are calculated using IEA's energy balances. MOSPI publishes the only free-of-charge source of India's energy balance in its energy statistics report. The issues in India's energy data and MOSPI's energy statistics have been raised in the past. However, there is little discussion on the shortcomings of India's energy balance reported in MOSPI's energy statistics. As the research on tracking progress in meeting climate targets and policy effectiveness is growing, it is crucial to identify the gaps and errors in the national energy balances and develop them to meet international standards.

This paper compares the energy balances from MOSPI's energy statistics and IEA energy balances. I find significant differences between the two energy balances. I compare the three blocks in which energy balances are divided. I use Niti Aayog's India Energy Dashboard and confirm that there are errors in MOSPI's energy balances. There are two key issues in the MOSPI's energy balances – an incorrect calorific value of coal and incomplete disaggregation of energy use by end-users. These issues lead to substantial differences in energy indicators and CO_2 emissions.

5.1. The calorific value of coal

The primary energy from coal in MOSPI data is higher than IEA, leading to the primary energy supply estimated from MOSPI data being 26% higher than IEA. This causes the per capita energy consumption and energy intensity to be 26% higher than IEA data. The efficiency of energy conversion, transmission, and distribution is reported to be 19% in MOSPI statistics but is 31% in IEA data. In MOSPI statistics, the energy intensity of the industry is 83% higher than in IEA data. The estimate of energy-CO2 emissions from MOSPI differs from IEA and gives a 31% higher estimate than IEA.

Calorific value is crucial to converting physical values into a standard energy unit. The energy balance tables in the MOSPI likely use the default calorific values given in the IRES (IRES 2017). This error in the assumption leads to a higher estimate of energy use, the intensity of energy use, and CO2 emissions. Many countries use default calorific values due to limited data. The calorific value of Indian coal is much lower than the global average.

India's coal is divided into several categories based on calorific values. The quantity used in each grade is available and should be used to determine the weighted average calorific value of coal at the national level. IEA computes the weighted average calorific value of Indian coal. MOSPI energy statistics should estimate and report the calorific value of coal for each year using grade-wise data on production and imports.

5.2. Disaggregation of energy consumption by end-users

Energy balances provide data on fuels used by end-use sectors. The fuels by different sectors are essential to quantify energy savings from energy efficiency improvements. The disaggregation of final energy use to end-users is complete in the IEA energy balance but incomplete in MOSPI's energy balance. Due to the incomplete disaggregation, the estimate of agriculture and transport energy intensity is much lower in MOSPI data than in IEA data. The method used to estimate transport energy intensity in MOSPI does not follow international practices. However, the transport energy intensity is incorrect as many oil products used in the transport sector are reported in the non-specified category.

The issue of incomplete disaggregation of final energy use by sectors should also be resolved. Decomposing energy intensities into energy efficiency and structure effects is a valuable way to estimate the impact of energy efficiency improvement in different sectors. Such analysis requires energy use data at the sector level. Further, the estimates of CO_2 emissions by activity are also needed to track better and design mitigation strategies for different economic sectors. The methodologies and standards to collect final energy use data from sectors have been developed and are being used by developed economies and international organisations.

One of the challenges in adopting better energy data management in India is that the dissemination of energy data is not institutionalised under legislation (Rai 2017). However, even though action against climate change is not covered under legislation in the country, India is still at the forefront of international efforts to contribute to meeting the climate change challenge. We regularly submit our emissions inventory as per requirements under UNFCCC. Similarly, India is actively tracking its sustainable development goals following international efforts to meet them. Hence, it may not be necessary to have a new institution or duplicate the efforts through other organisations to meet the energy data challenge. MOSPI energy statistics are published under a well-established process. Efforts to improve it can provide the necessary support for tracking India's development and climate goals.

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